CLAIMS

What is claimed is:

1. An apparatus in a distributed control system, comprising:

a first network interface for communicating with a first network having a communication protocol stack; and

a device access agent for mapping at least one legacy format service message of said distributed control system to a network format messages compatible with said communication protocol stack.

2. The apparatus according to claim 1, wherein:

said first network comprising a commercial off-the-shelf Ethernet network.

3. The apparatus according to claim 2, further comprising:

a high speed Ethernet management agent for managing transport control protocol, user data protocol, and Internet protocol layers of said communication protocol stack; and

a high speed Ethernet management agent interface through which said device access agent communicates with said high speed Ethernet management agent.

4. The apparatus according to claim 3, further comprising:

a user data protocol local interface through which said device access agent communicates with a user data protocol layer of said communication protocol stack.

5. The apparatus according to claim 4, further comprising:

a transport control protocol local interface through which said device access agent communicates with a transport control protocol layer of said communication protocol stack.

6. The apparatus according to claim 5, wherein said high speed Ethernet management comprises:

a management information base constructed with a standardized structure to thereby allow an open and interoperable profile, and to make said apparatus to appear as a well behaved node.

7. The apparatus according to claim 1, further comprising:

a network management information base for storing information necessary for managing operation of said distributed control system; and

a network management information base local interface through which said device access agent communicates with said network management information base.

8. The apparatus according to claim 7, further comprising:

a system management information base for storing system configuration information of said apparatus; and

a system management information base local interface through which said device access agent communicates with said system management information base.

9. The apparatus according to claim 8, further comprising:

a system management kernel for configuring said apparatus and storing system configuration information in said system management information base; and

a system management kernel local interface through which said device access agent communicates with said system management kernel.

10. The apparatus according to claim 9, further comprising:

a local time clock for providing a local time for use within said apparatus; and

a system time clock for providing a system time across said distributed control system;

wherein said system management kernel synchronizes said local time clock with said a system time clock.

11. The apparatus according to claim 10, further comprising:

a redundancy entity for sending and receiving diagnostic information over said first network; and

a redundancy entity local interface through which said device access agent communicates with said redundancy entity.

12. The apparatus according to claim 11, wherein:

said first network interface comprises a redundant plurality of first network interfaces;

wherein said first network comprises a redundant plurality of first networks: and

wherein said redundancy entity maintains a network status table indicating diagnostic status of said distributed control system to select operational one of said redundant plurality of first network interfaces based on said network status table.

13. The apparatus according to claim 10, further comprising:

at least one function block application process virtual field device for providing standardized definitions of inputs, outputs, algorithms, control variables, and behavior of said distributed control system; and

at least one function block application process virtual field device interface through which said device access agent communicates with said at least one function block application process virtual field device.

14. The apparatus according to claim 1, further comprising:

a second network interface for communicating with a second network using said at least one legacy format service message.

15. The apparatus according to claim 14, wherein said second network interface comprises:

a plurality of second network interfaces.

16. An open interoperable apparatus in a distributed control system, comprising:

a local time clock for providing a local time for use within said apparatus;

a system time clock for providing a system time across said distributed control system; and

a system management kernel for synchronizing said local time clock with said system time clock.

17. The open interoperable apparatus in accordance with claim 16, further comprising:

a first network interface for communicating with a first network having a communication protocol stack;

a device access agent for mapping at least one legacy format service message of said distributed control system to a network format messages compatible with said communication protocol stack; and

a system management kernel local interface through which said device access agent communicates with said system management kernel.

18. An open interoperable apparatus in a distributed control system, comprising:

a redundant plurality of first network interfaces for communicating with respective ones of a redundant plurality of first networks having a communication protocol stack; and

a redundancy entity configured to send and receive diagnostic information through said redundant plurality of first network interfaces, said redundancy entity maintaining a network status table indicating diagnostic status of said redundant plurality of first networks, and said redundancy entity being configured to select an operational one of said redundant plurality of first networks based on said network status table.

19. The open interoperable apparatus according to claim 18, further comprising:

a device access agent for mapping at least one legacy format service message of said distributed control system to a network format messages compatible with said communication protocol stack; and

a redundancy entity local interface through which said

device access agent communicates with said redundancy entity.

20. The open interoperable apparatus according to claim 19, further comprising:

a system management kernel for configuring said apparatus and synchronizing a local time clock, which provides a local time for use within said apparatus, with a system time clock, which provides a system time across said distributed control system; and

a system management kernel local interface through which said device access agent communicates with said system management kernel.

21. An open interoperable distributed control system, comprising:

at least one first network having a communication protocol stack; and

at least one device in communication with said at least one first network, said at least one device having an access agent for mapping at least one legacy format service message of said open interoperable distributed control system to a network format message compatible with said communication protocol stack.

22. The open interoperable distributed control system according to claim 21, wherein:

said at least one first network comprises a commercial off-the-shelf Ethernet network.

23. The open interoperable distributed control system according to claim 21, wherein said at least one device further comprises:

a system management kernel for configuring said apparatus and synchronizing a local time clock, which provides a local time for use within said apparatus, with a system time clock, which provides a system time across said distributed control system; and

a system management kernel local interface through which said device access agent communicates with said system management kernel.

24. The open interoperable distributed control system according to claim 21, wherein:

said at least one first network comprises a redundant plurality of first networks; and

wherein said at least one device further comprises:

a redundancy entity configured to send and receive diagnostic information to and from said redundant plurality of first networks, said redundancy entity maintaining a network status table indicating diagnostic status of said redundant plurality of first networks, and said redundancy entity being configured to select an operational one of said redundant plurality of first networks based on said network status table.

25. The open interoperable distributed control system according to claim 24, wherein:

said redundant plurality of first networks comprises a redundant plurality of commercial off-the-shelf Ethernet networks.

26. The open interoperable distributed control system according to claim 21, further comprising:

a plurality of second networks, each of said plurality of second networks using said at least one legacy service message format;

wherein said at least one device comprises a redundant plurality of devices, each of said redundant plurality of devices comprises:

a plurality of second network interfaces for communicating with said plurality of second networks; and

a redundancy entity configured to provide information necessary for selection of an operational one of said redundant plurality of devices based on a network status table indicating diagnostic status of at least one of said redundant plurality of devices and said at least one first network.

27. A method of synchronizing a plurality of device specific local times and a system time in an open interoperable distributed control system, said plurality of device specific local times being associated with respective ones of devices in said open interoperable distributed control system, said method comprising:

detecting an end of a previous operational cycle;

providing a start time of a next operational cycle to each of said plurality of devices;

computing an offset between each of said plurality of device specific local times and said system time;

synchronizing each of said plurality of device specific local times with said system time using said computed offset; and

aligning said plurality of device specific local times with respect to each other so that said start time of said plurality of devices coincide.

28. The method of synchronizing a plurality of device specific local times and a system time in accordance with claim 27, further comprising:

providing a time master in said open interoperable distributed control system, said time master maintaining a global time;

determining whether said system time is synchronized with said global time; and

setting a synchronized flag if it is determined that said system time is synchronized with said global time.

29. The method of synchronizing a plurality of device specific local times and a system time in accordance with claim 27, wherein said step of aligning said plurality of device specific local times comprises:

computing an offset between each of said plurality of device specific local times with respect to each other; and

adding a time delay to at least one of said plurality of device so that said start time of each of said plurality of devices coincide with respect to each other.

add C1 B1